CLASSROOM STRATEGY USING CONSTRUCTIVIST APPROACH FOR TEACHING-LEARNING SUSTAINABILITY CONCEPTS IN A UNIVERSITY CONSTRUCTION COURSE

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DEDICATION

To my husband, Meeftah, for always being supportive and understanding.

To my daughter, Farah Izzati, for always believing and caring.

To my late parents, Md Nurdin and Zaleha, for always being the wonderful motivators that they were.

And to all the family members, THANK YOU.

Thank you for your loving support and belief in my dreams

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ABSTRACT

The concept of sustainable development has been introduced to the global stage by the United Nations. To achieve sustainable development, education is an essential tool. Education for Sustainable Development (ESD) is becoming increasingly important at all levels of the educational system including Higher Education Institutions (HEI). Many HEI have taken the initiative to integrate the concept of sustainable development into their curriculum and educational activities. Thus, the integration of teaching and research is becoming a key issue in higher education. There is no exact pedagogy for sustainable development education, but there is a broad consensus that it requires a shift toward active, participative, and experiential learning methods that engage learners and make a difference to their understanding, thinking and ability to act. The main objective of this study is to explore the application of the constructivist approach as the instructional design in sustainable development education. This research employs both quantitative and qualitative methods. The sample consists of Civil Engineering Diploma students. A set of survey questionnaire has been administered among them. Eleven respondents underwent semi-structured interview. The respondents were also given the pretest and posttest at the beginning and the end of the semester as well as an open-ended questionnaire in the classroom. They also did field trip report and group work assignment. Generally, this study contributes to the pool of knowledge in teaching and learning pedagogy which eventually will help to educate students on sustainable development more effectively.

ABSTRAK

Konsep pembangunan mapan telah diperkenalkan ke pentas dunia oleh Pertubuhan Bangsa Bangsa Bersatu. Untuk mencapai pembangunan mapan, pendidikan menjadi instrument penting. Pendidikan bagi pembangunan mapan menjadi semakin penting di semua peringkat pendidikan termasuk di institusi-institusi pengajian tinggi. Banyak institusi pengajian tinggi telah mengambil inisiatif untuk mengintegrasikan konsep pembangunan mapan dalam aktiviti pendidikan dan kurikulum mereka. Oleh itu, intergrasi pengajaran dan penyelidikan telah menjadi satu isu penting dalam pengajian tinggi. Tidak ada satu pedagogi yang tepat bagi pendidikan pembangunan mapan tetapi terdapat satu kesepakatan umum yang mengatakan bahawa ia memerlukan perubahan ke arah pendekatan pendidikan yang aktif, mengutamakan penglibatan pelajar dan memberikan pengalaman kepada pelajar yang mana ini akan memberikan perbezaan dalam cara mereka memahami, cara pemikiran dan keupayaan mereka untuk bertindak. Objektif utama kajian ini adalah untuk meneroka applikasi pendekatan konstruktivis sebagai rekabentuk pengajaran dalam pendidikan pembangunan mapan. Kajian ini mengunapakai kedua-dua kaedah kualitatif dan kuantitatif. Sampel terdiri daripada pelajar Diploma Kejuruteraan Awam. Satu set borang kajiselidik telah diedarkan di kalangan mereka. Sebelas responden menjalani temubual separuh berstruktur. Responden juga diberikan pra dan pasca ujian di awal dan akhir semester dan juga menjawab soal selidik terbuka ketika kelas berlangsung. Mereka juga menulis laporan lawatan lapangan dan tugasan kerja berkumpulan. Secara umumnya, kajian ini menyumbang kepada pengetahuan tentang pedagogi pengajaran dan pembelajaran dimana akhirnya akan mampu menbantu mendidik para pelajar dalam pembangunan mapan dengan lebih berkesan.

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DESD	-	Decade of Education for Sustainable Development
ESD	-	Education for Sustainable Development
GHESP	-	Global Higher Education for Sustainability Partnership
GUNI	-	Global University Network for innovation
HEI	-	Higher Education Institutions
HESD	-	Higher Education for Sustainable Development
IAU	-	International Association of Universities
ISO	-	International Organisation for Standardisation
NGO	-	Non-governmental Organisations
SD	-	Sustainable development
SPSS	-	Statistical Package for the Social Sciences
ULSF	-	University Leaders for a Sustainable Future
UN-DESD	-	UN Decade of Education for Sustainable Devel
UNEP	-	United Nations Environment Programme
UNESCO	-	United Nations Educational, Scientific and Cultural Organization
UNU	-	United Nations University
WCED	-	World Commission on Environment and Development
WSSD	-	World Summit on Sustainable Development
NFPCM	-	Needham's Five Phase Constructivist Model

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Today sustainability has recognised as a crucial issue faced by the twenty first century society (Komiyama & Takeuchi, 2006). Through education people become conscious of the need to preserve resources and safeguard the environment while in quest of economic growth. The concept of sustainable education is pursuing the balance between environmental conservation, economic growth and social development WCED 1987. In 1992 at the Rio Earth Summit United Nations highlighted the importance of education in attaining sustainable development.

In 2002 UNESCO declared the Decade of Education for Sustainable Development DESD from January 2005 to December 2014. United Nations stressed a rigorous work plan to develop environmental education around the world to recognise sustainable development. This appeal is in line with Chapter 36 of Agenda and was restated at the meeting in Johannesburg in 2002. The main purpose of sustainable education is to transform students' perception toward sustainability which then should change students' attitude in order to put into action the concept of sustainability (Cotgrave & Alkhaddar, 2006). Arbaat Hassan stated the need for efforts to be made to change young people's environmental perception (Arbaat Hassan, 2013) because young people would eventually be affected. Hence there is a need to formulate solutions for environmental problems. The environmental education (Brody & Ryu, 2006) should play a vital role in building awareness and changing people's values, skills, attitude and behaviour. Additionally, students'

perceptions toward the environment (Noora Kokkarinen, 2010) can be related to a variety of educational establishments. A study done has reported that although students' background did affect attitudes, education (Horvath, 1999) was the most important factor that influenced their attitudes towards environment. A subsequent study concluded that factors such as the educators' knowledge on sustainability and sustainable development (Segalàs, 2009) were able to affect attitudes toward sustainability. Because of this logical transformation from education to behaviour, students' behaviour toward sustainability can be transformed by changing their attitudes, which is considerably inspired by sustainable education.

The main objective of Decade of Education for Sustainable Development (DESD) is to assimilate concept of sustainable development into all features of education and learning. This educational strategy will inspire changes in behavior that will create a more sustainable future in terms of environmental, economic and a just society for the present and future generations. The Decade of Education for Sustainable Development DESD, also offers governments of the world the opportunity to rethink and reorient various scopes of education and skills training (DESD, 2002) so that the learning process is related to real life applications and supports learners to view the world through concern for sustainability and sustainable development.

Through Education for Sustainable Development (ESD) any students or any individual will be able to attain the necessary knowledge, skills, attitudes and values necessary to shape a sustainable future. Education for Sustainable Development (ESD) is where the important of sustainable development concerns such as climate change, (DESD, 2002) disaster risk reduction, biodiversity and sustainable consumption are included into teaching and learning (Lambrecht, 2011). Education for Sustainable Development (ESD) also requires teaching and learning methods that could successfully result in behavior changes in learners, where they are more likely to take actions or make conclusions with respect to sustainable development. Furthermore, it is also suggested that Education for Sustainable Development (ESD) could boost competencies like critical thinking, imagining of future scenarios and decisions making (Barth, 2007).

1.2 Background of Problem

In Tbilisi Declaration 1977, Higher Education Institutions (HEI) were requested to consider development of environmental programs. The program would provide the faculty and staff with environmental awareness, specialise training, participation in international and regional co-operative projects, and advise and educate the public regarding environmental issues (Wright, 2014). UNESCO-UNEP also stressed that Higher Education Institutions (HEI) should be the centre for research, teaching and training of qualified personnel, who must be acessible to undertake research on environmental education. The Higher Education Institutions (HEI) are responsible to train experts in formal and non-formal education. The environmental education in colleges and Higher Education Institutions will differ from traditional education. They would teach students vital basic knowledge for work in their future profession.

One of the education disciplines which are directly related to human activities and the nature is the engineering discipline. Some of the Civil Engineering works include buildings, bridge, railway lines, airport construction and other structure and infrastructure. However, the construction of any of the buildings and infrastructures has an impact the current environment in several ways. The impacts of a construction project may include: noise caused by operating plant and construction equipment, air pollution due to dust from earthworks or emissions from plant and equipment, water pollution due to soil erosion ,waste disposal due to spoil, water discharges due to dewatering excavations, and heavy blasting and traffic impacts from detours and motorist inconveniences (Simon 2012). Traffic movement may also be affected by lane closures and temporary diversions and delays due to congestion and longer routes. Hence, the stakeholders in the construction industry must play their roles well in ensuring that the environment is protected and conserved by incorporating sustainability in their work. Thus, it is vital for engineers who are one of the main stakeholders in the industry to be knowledgeable of sustainable development. This is the first move to ensure that environmental impacts of their deeds are considered in all the decisions made in their positions.

When this study was conducted and based on the curriculum content of the UTM Diploma programme in 2007 there has been no indication of Education of Sustainable Development being operationalized in the Diploma programme. Until the present time, there is still lacking of sustainable development elements in the Civil Engineering Construction course. The detail of the Civil Engineering Construction course outline is given in Appendix A, which included the weekly schedule and assessment. The content of the weekly reflect the lecture topics and there is no element of sustainable development incorporated in those topics. Based on the course outline, it can be said that the nature of the topics is very much teacher orientated. This means that the teacher dominates the teaching process and the students merely receiving information without much participation. Therefore, it is recommended that the university considers incorporating knowledge on sustainable development into the programme especially Civil Engineering Construction course.

1.3 Statement of the Problem

A study done by Cotgrave and Alkhaddar (2006) stated that the most relevant aspects of sustainability to construction course students were to develop an understanding of the principles of sustainable construction during the design and construction phases. Developing knowledge of sustainable construction is important because many of these graduates will gain employment with contractors that undertake design and build contracts. They may therefore be in a position to influence designer's choice of materials and systems, and also promote more sustainable practices via the design and construction process. An awareness of the environmental impact of a building over its whole life is also very useful, and this is closely linked to the initial design (Cotgrave & Alkhaddar, 2006). Thus, it is justified that the knowledge of sustainable development needs to be included into the engineering curricula.

The challenge is most engineering courses mainly emphasis on 'memorisation of facts and well-established procedures' (Huntzinger, 2007). On the other hand, the effective teaching and learning of sustainable development

knowledge requires students to solve complex and ambiguous problems which require creative and critical problem solving skills. Unlike needing to memorise facts or solve straight forward equations. Hence, it is an essential to consider the best way not just to incorporate the concept of sustainable development into engineering curriculum, but also the appropriate approach to teach the relatively 'subjective' knowledge to engineering students which are used to be given facts and formulas. A strategic, well thought and holistic approach (Giesen, 2006) in incorporating the knowledge will ensure the effective learning of students which are the hope for a better and more sustainable future.

Based on the literature review it was considered that constructivist approach in teaching and learning of sustainable development is most appropriate to be used in this research (Kocevar-Weidinger, 2004). It is believed that learning occurs as learners are actively involved in a process of learning and knowledge construction rather than passively receiving information. The students are responsible for their own learning and knowledge construction. They assist their colleagues to learn and ultimately lead to create an atmosphere of satisfaction and achievement among themselves.

In this study, the preferred teaching and learning approach is constructivism. Constructivism is basically a theory of learning about how students learn. One of the applications of constructivism in teaching is to solve ill-defined and ill-structured problems which involve higher order thinking skills, such as understanding, applying, evaluating, and creating (Preissinger, 2015). Many of these ill-defined and ill-structured problems are related to everyday or real-life problems. Many experts believe that environmental and sustainability problems are considered as everyday problems. These problems are for example climate change, resource depletion and pollution. They are known as Wicked Sustainability Problems (WSPs). WSPs are highly complex, challenged, and lack definite solutions (Lonngren & Svanstrom, 2015). In order to solve these problems it requires holistic approaches and most of these approaches are beyond technical systems analysis and optimization. Integrating sustainable development into the Civil Engineering Construction course has the potential of playing a crucial role in preparing students to deal with the mentioned problems. The students' potentials, skills and capabilities can be developed through

the integration of sustainable development in the course. With the employment of constructivist approach, which is student-centred approach, the students can get themselves involved greatly in the learning process.

The Needham's Five Phase Constructivist Model (NFPCM) is selected as the teaching model in this study. This model consists of five phases namely, orientation, generating ideas, restructuring the ideas, applying the ideas and finally reflection. In this model, each phase is explained and suggestions are given on the activities which are suitable to be conducted in class. The NFPCM is chosen for this study due to several reasons. The first is that this model has five phases that are helpful and easily conducted by teachers especially those who are inexperience in conducting lessons using the constructivist approach. The second reason is based on the literature review conducted, this model receives the most positive responses among researchers. The findings of their work show that this model works well in classroom (refer Table 2.9). The third reason is that this model is adaptable to other programs and the suggested activities can be adjusted to o levels of difficulty and thinking. Finally, this model offers room for students to participate more actively since it is student-centered. It can provide students to gain more experience and knowledge so that learning can be meaningful to them. All these are illustrated in Table 2.9. Therefore, this study will employ the Needham's Five Phase Constructivist Model (NFPCM).

1.4 Research Objectives

The main objective of this research is to employ a constructivist approach in teaching and learning in classroom setting to incorporate the knowledge on sustainable development into the Civil Engineering Construction course. The incorporating of sustainable development knowledge into the course will increase awareness and encourage changes in behaviours and attitudes of the students so that they will be able to contribute to a more sustainable future. The teaching and learning of sustainable development will ensure that the students will take into consideration not just scientific and technical knowledge toward the environment (Matsuura, 2007) aspects of a project but also environmental, economic and social aspects. In

sustainable development learning environment, in solving problems, students have to consider not only scientific and technical aspects of the problem, they too have to consider the environmental, economic and social matters. These three aspects are considered vital toward achieving sustainable development. The research objectives (RO) of the study are as follows:

i. To determine the awareness of sustainable development among engineering students.
ii. To determine the students' knowledge on sustainable development through the pretest and posttest conducted.
iii. To examine the students' knowledge on sustainable development after using Needham's Five Phase Constructivist Model (NFPCM) in the classroom setting.
iv. To produce a guideline on teaching and learning approach in integrating knowledge on sustainable development in Civil Engineering Construction course based on constructivist approach.

1.5 Research Questions

To achieve the above research objectives, the following research questions (RQ) are used.

Objective 1: To determine the awareness of sustainable development among engineering students.

RQ1. What is the engineering students' awareness toward sustainable development?

Objective 2: To determine the students' knowledge on sustainable development through the pretest and posttest conducted.

RQ2. What is the knowledge that the students' have on sustainable development through the pretest and posttest conducted?

Objective 3: To examine the students' knowledge on sustainable development after using the Needham's Five Phase Constructivist Model (NFPCM) in the classroom setting.

RQ3. What is the students' knowledge on sustainable development after using the Needham's Five Phase Constructivist Model (NFPCM) in the classroom setting?

Objective 4: To produce a guideline on teaching and learning approach in integrating knowledge on sustainable development into Civil Engineering Construction course based on constructivist approach.

RQ4: What are the components of the guideline on teaching and learning approach in integrating knowledge on sustainable development into Civil Engineering Construction course based on constructivist approach?

1.6 Conceptual Framework

The conceptual framework for this research is shown in Figure 1.1. A conceptual framework can be represented in graphical form or written in narratives form. The conceptual framework can assist the researcher in deciding the types of data to collect and also the variables to be considered. In this research there are two independent variables. A variable is defined as anything that has a quantity or quality that varies. It is a characteristic or attribute of an individual or an organization that (i) researchers can measure or observe and (ii) varies among individuals or organizations studied. An independent variable is a variable believed to affect the dependent variable. This is the variable that the researcher, will manipulate to see if it makes the dependent variable change. In this study the independent variables are knowledge on sustainable development and awareness of sustainable development.

In this context the knowledge on sustainable development is applying the concepts, principles and practices of sustainable development to building and

construction industry. Apart from the technical knowledge, sustainable development should also take into consideration the economy, environment and social aspects. Awareness in this study refers to grasp on having the concern and sensitivity towards the environment and its problems. Thus, in the context of this research the awareness covers five aspects which are (i) the perception of sustainable development (ii) attitudes towards sustainable development (iii) environmental consciousness (iv) attitude to change and finally (v) personal views on incorporating knowledge on sustainable development into Civil Engineering Construction course.

A dependent variable is an attribute or a characteristic that is dependent on or influenced by the independent variable. An independent variable is an attribute or characteristic that influences or affects an outcome or dependent variable (Creswell, 2003). In this study, the dependent variable is will be understanding of sustainable development. The understanding of sustainable development is manifested through the guideline in which it provides the appropriate teaching and learning approach, learning strategy and appropriate evaluations to be implemented. This guideline is based on Needham's Five Phase Constructivist Model (NFPCM).

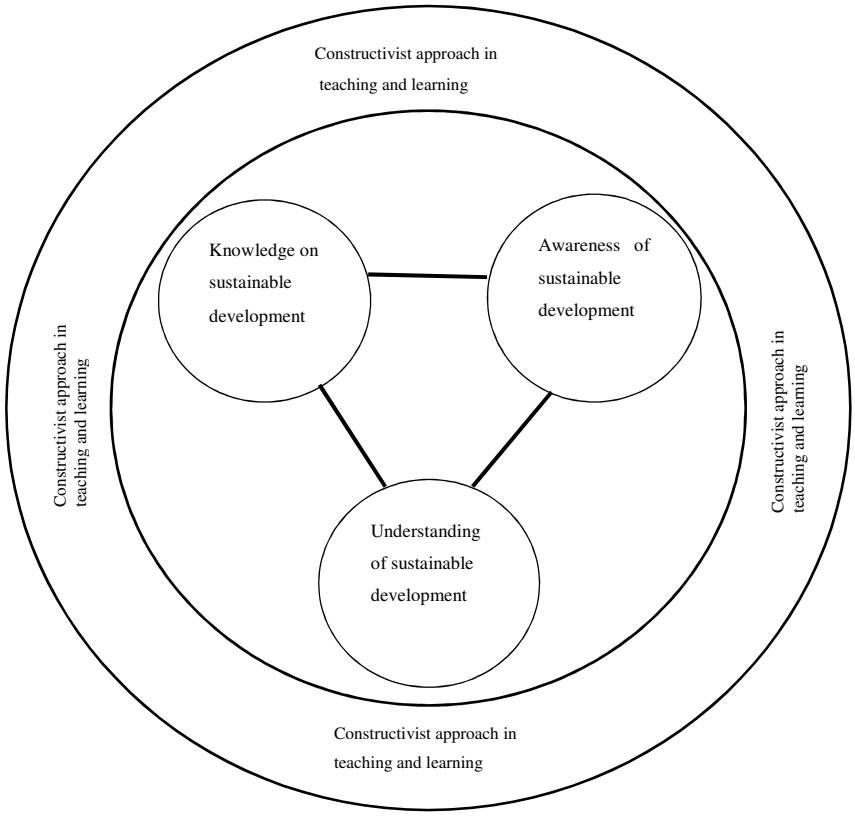

Figure 1.1 Conceptual framework

1.7 Significance of the Research

The research will contribute to the body of knowledge in teaching and learning sustainable development in Civil Engineering Construction course. Successful integration of sustainable development knowledge into engineering curriculum requires a change in the teaching and learning approaches. Effective teaching and learning of sustainable development knowledge through engineering courses would result in future engineers who are able to (ESD, 2014):

i. consider what the concept of global citizenship means in the context of their own discipline and in their future professional and personal lives
ii. consider what the concept of environmental stewardship means in the context of their own discipline and in their future professional and personal lives
iii. think about issues of social justice, ethics and wellbeing, and how these relate to ecological and economic factors
iv. develop a future-facing outlook; learning to think about the consequences of actions, and how systems and societies can be adapted to ensure sustainable futures.

1.8 Scope and Limitation of the Research

This research will limit its scope to incorporate knowledge on sustainable development into construction course. In Malaysia, the awareness of sustainable development in Civil Engineering students is still not at large (Shafii, Arman Ali, & Othman, 2006). It has been recognized that the building and construction industry has an enormous responsibility within the environmental debate. Each individual, organization and institution has an obligation to consider ways to protect the environment and reverse the damage done to it over the past decades (Peter Paa-Kofi 2013). The proposed classroom approach could act as a guideline for teaching and learning sustainable development into other Civil Engineering courses.